Telescopic Spectacles and Magnifiers as Aids to Poor Vision

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TELESCOPIC SPECTACLES AND MAGNIFIERS AS AIDS TO POOR VISION*

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In recent years, it has been possible in certain types of cases to improve the vision that with the best possible correction has been unsatisfactory. This has been accomplished by the adoption of the principle of a telescope to a form for permanent use. The increase in visual acuity results from enlarging the retinal image.

The first attempts were made in 1646 by Kircher, who modeled a hand telescope. In 1667, Eschinardi designed a telescopic spectacle for near use. Similar experimental instruments were proposed and made during the eighteenth century by Zahn, C. G. Hertel, J. F. Meyen, B. Martin and J. Stack. In 1749, small hand telescopes for theater use were designed by M. Thomin and sold in Germany as "hand or pocket perspectives" and in France under the trade name "lorgnettes." They were utilized also for the correction of ametropias. The use of these continued until about 1819. In 1786, Dixon designed a telescopic spectacle from two spherical mirrors, which he later compensated by two spherical lenses.

In the nineteenth century, Chevallier proposed his binocular telescopic spectacle, and further advances were made by Peytal with his kallioscope, Boudry, Steinheil, Schonstedt, Tolles, Pontis, Ludwigs, Delcartes, Chiesas, Winslow and Mauthner.

In the last few years, remarkable strides have followed the improvements suggested by Teixeira da Aragaos, Denman, Plehn and Gleichen, von Rohr, Scott, Landesberg, Muller, Goldschmidt, Nitsche and Gunther, Reitschens, Lauber, Henker and Stock. Since 1909, the Zeiss Company has marketed the telescopic spectacles and magnifiers, making such rapid improvements in the

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last few years that excellent results are now being obtained in prescribing them for the extremely near-sighted and amblyopic patients, regardless of whether such amblyopia is congenital, traumatic or due to disease.

CONSTRUCTION OF THE TELESCOPIC SPECTACLE

The telescopic spectacle is constructed according to the design of a Dutch telescope builder. Each optical combination consists of two components in a metal

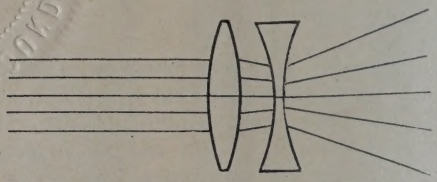

Fig. 1.—Principle of a telescope: a converging anterior lens and a diverging posterior lens.

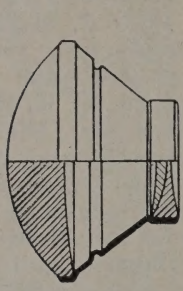

Fig. 2

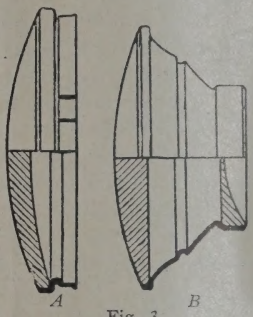

Fig. 3

Fig. 2.—A correcting telescopic spectacle for moderate ametropia in natural size, with a large converging front lens, a small diverging rear lens and the correcting lens behind that to correct the ametropia.

Fig. 3.—*A*, converging object-side lens attachment, which is used for reading, t obe attached to *B*, which here is shown as a correcting telescopic spectacle for a highly myopic patient. The large converging front lens and the smaller diverging rear lens are of natural size.

mount; a large covering lens and a smaller diverging lens. The two lenses are so computed as to insure a view free from distortion, from astigmatism of oblique rays, and from disturbing color defects. By a proper combination of the component parts, the anterior converging lens converges the rays, which are then made divergent by the posterior lens, and so arranged to give a magnifying effect of 1.3, 1.8, and sometimes greater without distortion.

One may duplicate the principle by taking two lenses from the ordinary trial case, say a + 5 and a — 10, holding the plus lens a few inches in front of the minus lens and viewing any object through the combination.

Each optical combination weighs about 13 gm. (a little less than one-half ounce), and the weight of the complete spectacle frame with glasses is about 30 gm., or slightly more than an ounce.

EFFECT OF THE TELESCOPIC SPECTACLE

By enlarging the retinal image, the weak-sighted or extremely near-sighted person improves his vision 1.3 or 1.8 times, according to the combination used. For instance, a patient having a vision of 0.2, or 10/50, secures with a 1.8 × telescopic spectacle, a vision of approximately 0.4, or 20/50, for distance use.

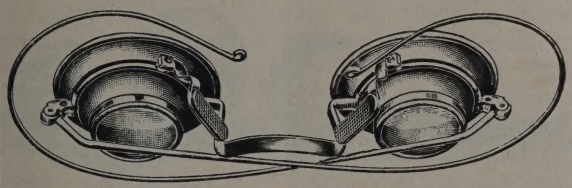

Fig. 4.—Telescopic spectacles complete.

For reading, writing and near work, examination has proved that a patient needs 0.5, or 20/40, vision; therefore, we are made to believe that a vision of not less than approximately 0.3 (20/60) is necessary before telescopic spectacles can be prescribed. However, such is not the case, as will be shown by tables and cases following, in which telescopic spectacles were prescribed successfully with a normally corrected vision of 0.1 (20/200). When the vision is still less, use is made of the telescopic magnifier to be discussed later.

Correcting telescopic spectacles were first proposed for highly myopic patients, and the problem was to give these patients, by means of the spectacle, vision as good as could be obtained by the successful performance of Fukala's operation of removal of the crystalline lens. By a proper arrangement of the component parts of the telescopic spectacle, there results a definite increase in the size of the retinal image in round figures of 30, 50 or 80 per cent., depending on the lesser or greater refractive power of the component parts of such a

system. One will scarcely be able to secure a magnification of more than 100 per cent. on account of the accompanying increase in the size of the spectacle.

Another important problem in addition to giving a definite increase in the size of the retinal image was in correcting the astigmatism of oblique pencils. Until a few years ago, attention had not been paid to this most important point, as may be gathered from the fact that many proposals had been made to give the component parts of such a system a variable separation. However convenient such an arrangement might be in making it adaptable to the ametropia of any individual, it is quite incompatible with the much more important requirement of exact reproduction over the whole field of vision. By suitably grinding both lenses in this component system, the astigmatism of oblique pencils is

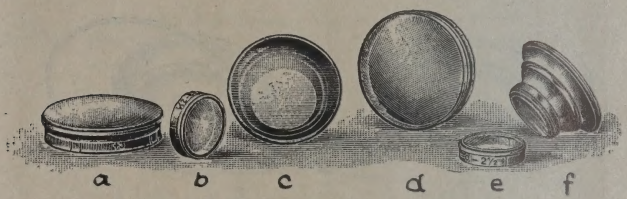

Fig. 5.—Optical components of telescopic spectacles with two eye-side and two object-side lens attachments: *c*, *f*, telescopic elements; *b*, *e*, eye-side additions to correct ametropia; *a*, *d*, object-side attachments for near use.

corrected; but, owing to the construction of the telescopic spectacles out of two systems of high refractive power, the angles of incidence and refraction are of considerable size, and, therefore, the astigmatism of oblique bundles is not necessarily corrected for all intermediate visual directions when it has disappeared for a certain extreme angle. The higher the magnification we desire, correspondingly more marked is the zonular astigmatism of oblique bundles.

If the field of vision be selected of such size as to render the astigmatic zones not noticeable, then the extent of the eye side field will vary, in inverse ratio, with the magnifying power of the telescopic lens; that is, the greater the magnifying power, the smaller will be the field. This relationship has already long been known to exist in similar instruments, such as the Gallilean telescopes. With the telescopic spectacle, a field of 40 degrees may be obtained with a magnifying power

of 1.3; but, in order to obtain a magnification of 1.8, this field must be reduced to 24 degrees.

The correction of oblique pencils in telescopic lenses is not limited to their astigmatism, but extends also to their distortion, and it is possible to correct this error as well as the astigmatism of oblique pencils. In addition to this, it is also possible to counteract the different inclinations of the principal colored rays.

For a simpler understanding, we will divide the discussion into: (*a*) telescopic spectacles for distance use, and (*b*) telescopic spectacles for near use.

TELESCOPIC SPECTACLES FOR DISTANCE USE

The telescopic spectacles enlarging 1.3 × are used for extremely near-sighted persons without marked changes in the fundus, who, with normal correction, still have good vision. The retinal image with these spectacles is increased approximately 30 per cent. in size, an improvement similar to that obtained by the operative removal of the lens. A visual field of approximately 40 degrees is obtained with 1.3 telescopic spectacles, and they are gladly worn by patients with good results.

Spectacles magnifying 1.8 × are used for the extremely near-sighted patients in whom changes in the fundus have reduced vision considerably, and in patients with amblyopia. Naturally, the visual field is decreased with the enlarged magnification.

TELESCOPIC SPECTACLES FOR NEAR USE

For use at reading distances, the telescopic spectacles must in most cases be arranged somewhat differently than telescopic spectacles designed for distance vision. Owing to the peculiar construction of these spectacles, the power of accommodation of even young persons is insufficient to render them available in reading as well as distance, for the alteration in the range of accommodation produced by telescopic spectacles is much greater than that produced by thin lenses, and this alteration is always in the direction of an increase in accommodative effort. With the proper distance correction, the additional lens reproduces the working surface at an infinitely distant plane. For this purpose, it is therefore necessary to append for near vision lens attachments on the converging lens, the side facing the object, or

special lens combinations computed for near. It is conceivable that there may be cases in which it will be better to place such an additional glass behind the diverging ocular lens.

The optical axes of near spectacles for use with both eyes should intersect at the proper working or reading distance; otherwise the patient will see double when the fusion effort is insufficient to maintain single vision.

Fig. 6.—Telescopic spectacle for high myopia.

THE FITTING OF TELESCOPIC SPECTACLES

It is absolutely necessary and imperative that the full correction be given in ordering these lenses. If the full correction is not ordered, the circles of diffusion are enlarged, and it is not unusual that the patient will see better without the telescopic spectacles.

To prescribe telescopic lenses accurately, one must first determine the best vision obtainable with the ordinary proper correction. Toward this end, Prof. O. Henker has designed a very accurate amblyopic chart (Fig. 8). Our case records will show that the use of the standard system is inaccurate to a certain extent; for example, a patient with a vision of 0.1

should have a vision of 0.2 with a telescopic spectacle 1.8 ×, yet we find possibly 0.3. By use of the Henker amblyopic chart, we should probably find the normally corrected vision 0.16, accounting for the 0.3 vision with the telescopic spectacle. The importance of the exact vision will be understood when we later discuss the graph from which one may know just what lenses and additions to prescribe.

We now proceed to a trial case fitting, using the lenses as supplied in a special telescopic spectacle trial Case (Fig. 9). There are three trial case outfits, one for highly myopic patients, magnifying 1.3 ×; one for highly myopic patients, magnifying 1.8 ×, and one for amblyopic patients, magnifying 1.8 ×.

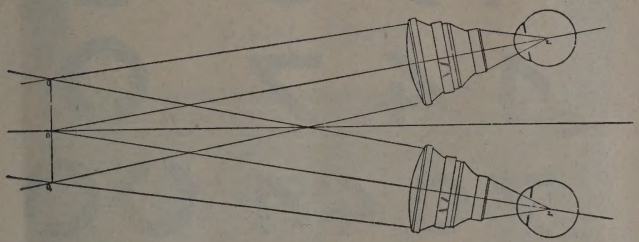

Fig. 7.—Position of two telescopic spectacle members in a combination designed for work at reading distance: 0, 0_1, 0_2 represent the object seen conjointly by both eyes.

The spherical lens attachments designed for facing the eye are fitted with spring clips by means of which they are readily attachable to the trial combinations. The cylindric lenses, on the other hand, must be attached in conjunction with a spherical lens attachment, or when the sphere is not needed, in conjunction with an intermediate collar.

The contents of the case are available for testing one eye only, the other being rendered inactive by the interposition of a blank disk; however by a suitable choice of systems and attachments, it is possible to form a series of pairs of systems of similar vertex refraction, in which case both eyes may be tested. Any trial frame may be used which has adjustments for interpupillary distance, height and set of the bridge.

When testing for near use, the reading attachments are placed on the side of the telescopic element facing the object. They are supplied in strengths of + 2, + 3, + 4, + 5, + 6, + 7, + 8, + 9 and + 10. The reading

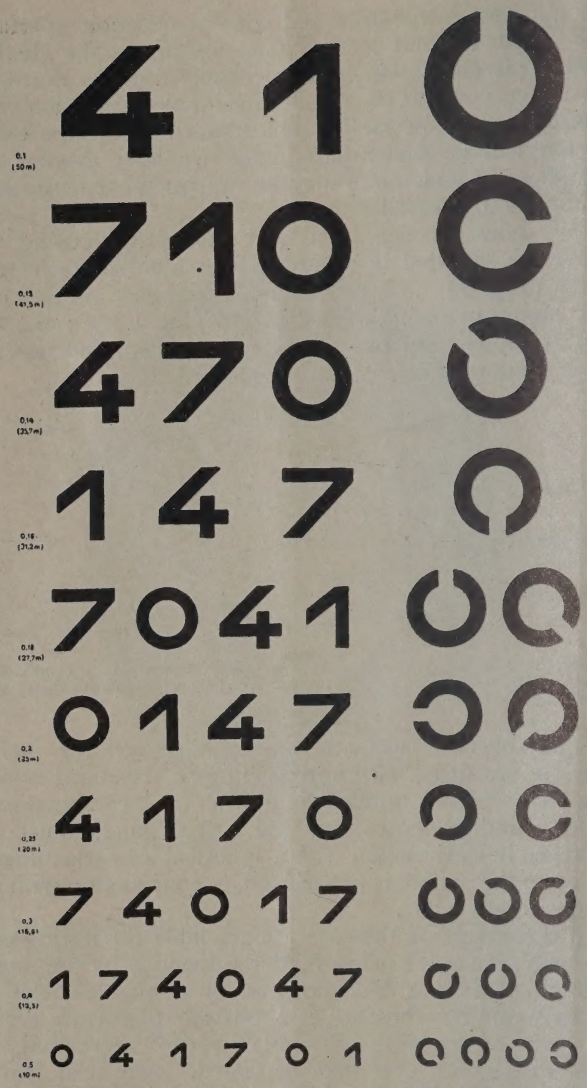

Fig. 8.—This chart records visual acuity between 0.5 and 0.1 with lines for 0.5, 0.4, 0.3, 0.25, 0.20, 0.18, 0.16, 0.14, 0.12 and 0.10. If the vision is less than 0.1, the distance between the chart and the patient may be reduced to one half, or if an accurate record of vision between 0.2 and 0.4 is desired, reflecting mirrors as may be needed to double this distance are utilized.

or working distance is always roughly equal to the focal length of the lens attachment. For the usual reading distances of 33, 25 and 20 cm. (13, 10 and 8 inches), the lens attachments should have + 3, + 4 and + 5 diopters, respectively. More powerful attachments should be reserved for those cases in which the visual

Fig. 9.—This particular trial set contains four telescopic elements, a 0, + 3, — 3, and a — 6, to which are added the necessary spherical and cylindric attachments making up a combination the exact refraction in the case under examination. These attachments are added to the magnifying elements on the side facing the eye, and if one has the two trial cases for amblyopic and myopic patients, suitable combinations ranging from — 32 to + 15 diopters can be constructed. Also, cylinder attachments up to 4 diopters are supplied.

capacity is so small as to necessitate, in addition to the telescopic magnification of 1.8 × furnished by the spectacles, a considerable amplification by the lens attachment. By a proper combination with front lens attachments, one can obtain an amplifying effect up to

4.5 ×, which raises a visual power of 0.1 (1/10) to about 0.5, the amount necessary to read satisfactorily.

The telescopic element gives us a magnification of 1.8 times, but how do we get the magnifications of as much as 4.5 times by the use of the object-side lens attachments to the telescopic elements?

The focal distance of a 4 diopter lens is 25 cm., and such a lens at such a distance does not produce any enlargement of the object seen through it. However, the object viewed through an ordinary + 8 lens at its focal distance appears twice the size; with a + 12 lens, three times the size. Magnifying glasses have been established on this principle. The enlargement produced is the relation of the diopter strength of the lens to 4 diopters, which at its focal distance produces no magnification. For example, a 10 diopter lens produces 10/4, or 2½ times magnification; a 6 diopter lens 6/4, or 1½ times magnification.

A patient with a normally corrected vision of 0.14 with a telescopic element of 1.8 × has a visual acuity of 0.25 for distance (1.8 × 1.4 = 0.25). With an object-side lens attachment for reading of + 8 (8/4, or 2 times magnification) there is produced for near 0.25 × 2, or a visual acuity of 0.50, which is half the normal reading standard and sufficient, as pointed out before, for satisfactory reading.

The telescopic spectacles magnifying 1.8 ×, in conjunction with the various object-side lens attachments, will furnish the magnifications given in Table 1.

TABLE 1.—*Magnifications Obtained by Telescopic Spectacles Magnifying One and Eight-Tenths Times, with Object-Side Lens Attachments*

Visual Acuity (as Found with a Fully Correcting Trial Glass) for Distance	Telescopic Combination			Reading Distance About	Diameter of the field of View About
	Lens attachment on the Side of the Object	Simple Lens Magnification	Increase of the Visual Acuity for Reading to		
1/3 = 0.33	+ 3 D.	1.35×	0.45	33 cm.	90 mm.
	+ 4 D.	1.80×	0.6	25 cm.	67 mm.
1/4 = 0.25	+ 5 D.	2.25×	0.56	20 cm.	54 mm.
1/5 = 0.2	+ 6 D.	2.70×	0.54	16 cm.	45 mm.
1/6 = 0.17	+ 7 D.	3.15×	0.53	14 cm.	39 mm.
1/7 = 0.14	+ 8 D.	3.60×	0.5	12 cm.	34 mm.
1/8 = 0.13	+ 9 D.	4.05×	0.53	11 cm.	30 mm.
1/9 = 0.11	+ 10 D.	4.50×	0.5	10 cm.	27 mm.
1/10 = 0.1	+ 10 D.	4.50×	0 45	10 cm.	27 mm.

In explanation of this table, let us take the fourth line for an example. In this case the patient has a distance visual acuity of 0.2 (20/100) with the best possible ordinary correction. A + 6 object-side lens attachment

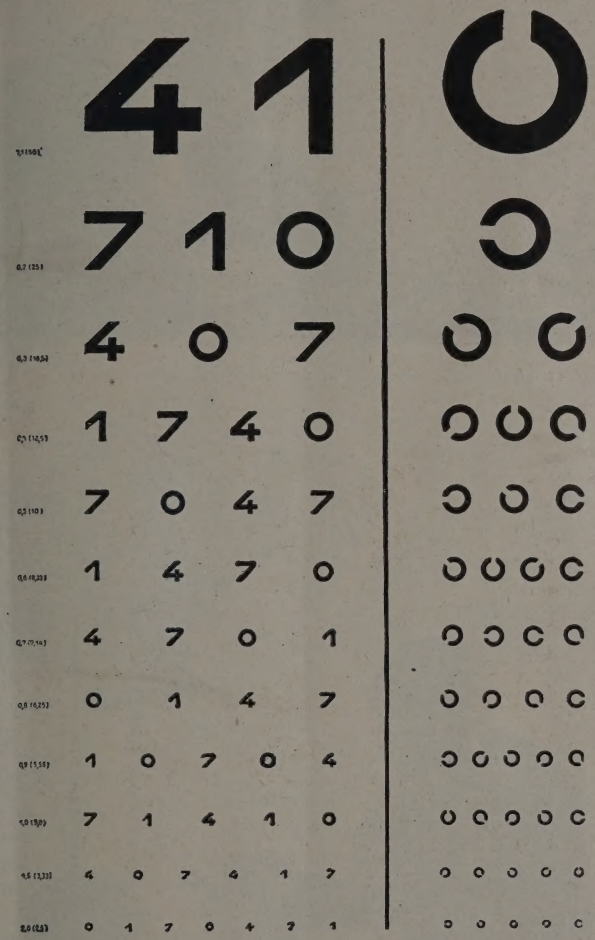

Fig. 10.—Hegner test type for testing near vision.

is added to the telescopic element in reading. This object-side lens attachment has a magnifying power of 1.5 in itself, which, times the magnifying power of the telescopic element of 1.8, gives a total lens magnification

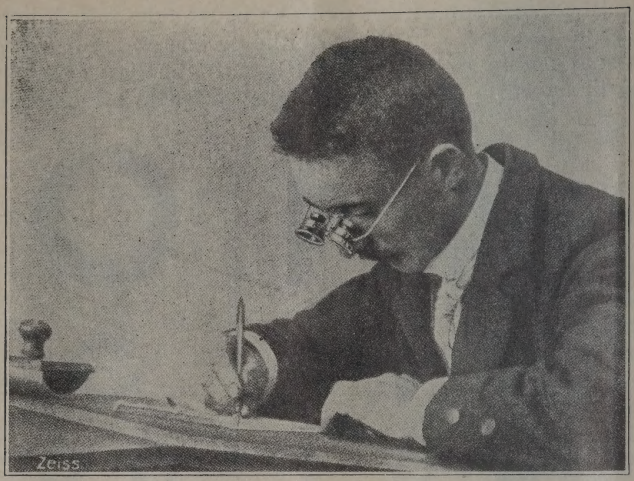

Fig. 11.—Telescopic spectacles with intersecting optical axes for writing.

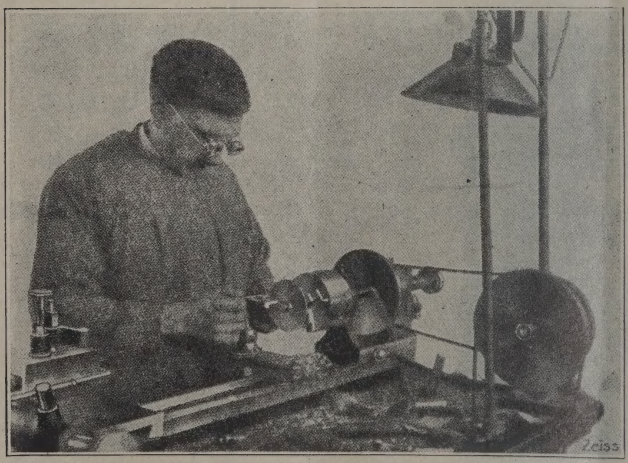

Fig. 12.—Telescopic spectacles with intersecting optical axes for working distances.

of 2.7 ($1.5 \times 1.8 = 2.7$), as given in the third column of the table. This magnification, times the normally corrected visual acuity, equals 0.54 (0.2x2.7). And, as mentioned previously, a patient with a vision of one-half the normal standard is able to read satisfactorily. However, with the increase in the magnifying power, the object read must be held closer, as shown by the reading distances in Column 5 of the table, and the diameter of the field of view is decreased, as seen in Column 6. Therefore, by knowing the normally corrected vision for distance, one can tell by this table what

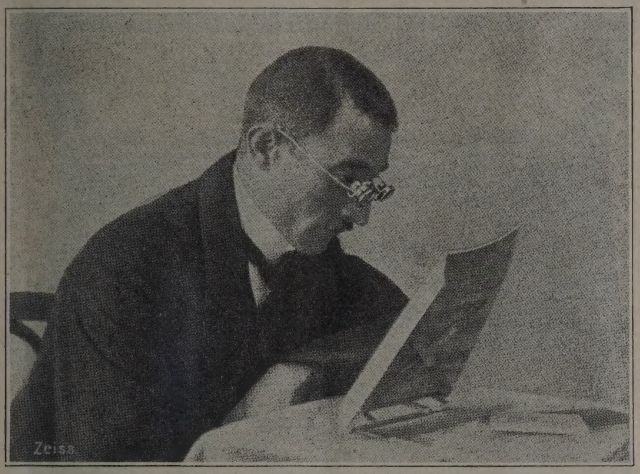

Fig. 13.—Telescopic spectacles in use for reading.

object-side lens attachment is necessary with this system magnification to bring the vision up to about one-half the normal standard, the amount necessary for reading. For our near tests we are content with the Jaeger test type recording same as J 1 or J 2 or with a notation that the patient can read the newspaper small type, or fiction. The German literature records same with the Birkhauser, Hegner or Nieden test type.

The Birkhauser or the Jaeger test type, such as we use, consists of continuous reading and is not an exact method, such as is noted with the Hegner test type (Fig. 10), which is here depicted five times magnified.

With this test chart it is only necessary to obtain 0.4 the normal vision (fourth line from the top), as the

numbers and Landolt rings are at least 20 per cent. more accurate and difficult to determine than the usual uninterrupted type.

When the visual acuity is so small that it is necessary to append object-side attachments in strengths of 6 diopters or more, the telescopic spectacles can be used only for one eye. Vision with both eyes is impracticable under these circumstances, owing to the magnitude of the angle at which the intersecting axes would have to meet (Fig. 7). For use with one eye, the same

Fig. 14.—The bridge fittings contained within this trial case are arranged according to interpupillary distances and bridge heights, so that a fitting for any case may be made.

pair of spectacles that is used for distance may be used for near work by adding each time the object-side lens; however, for use with both eyes, two separate pairs are needed, viz., the distance spectacles with parallel axes and the near spectacles with intersecting optical axes (Figs. 6, 11, 12 and 13).

After several determinations of the lenses required for the improvement of vision, a provisional telescopic spectacle is fitted by aid of the frame case (Fig. 14) and the patient allowed to wear them for a few days, thereby obtaining an exact estimate of the effect of the selected combination. Practical experience has shown that in the majority of cases, spectacle wearers acquire

within a few days the ability of taking full advantage of the magnifying effect, and that at the end of that period they can see better than at first.

After a few days, the amblyopic patient accustoms himself to the enlarging effect of the telescopic combination, which makes objects appear very much closer, and in a short while the patient will wear them consistently. Owing to the effect of the telescopic elements, which makes objects appear much closer the patient will stumble and feel unsafe; therefore, they should be worn with care at first. Young patients will accustom themselves to the changes in a day or two, while with the older it takes a longer time. It would be best to allow the patient to wear the provisional trial outfit at home and in familiar places, so that he will accustom himself to the changes more quickly and assuredly.

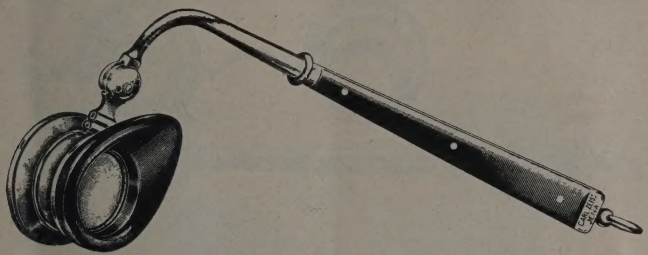

Fig. 15.—Monocular telescopic lorgnette with eye cup.

A special form is supplied that requires exact fittings and measurements in order to make up a proper pair of telescopic spectacles for use. When fitting telescopic spectacles, care should be taken to insure that either combination is centered accurately with respect to the eye. The distance between the apex of the eye-side lens and the corneal apex should be 12 mm. wherever possible. In cases of very pronounced ametropia, say from 6 diopters upward, differences in the distances of the vertices of the trial lens and the telescopic spectacle trial combination from the corneal vertex must be taken into consideration.

The telescopic spectacle frames as worn by the patients in Figures 6, 11, 12 and 14 are of a special design to suit the peculiar form of the optical combinations, and are adapted to carry their somewhat greater weight. The spectacle frame is made of nickel. In addition to

the nasal bridge of the pattern, which is made to rest on the middle of the root of the nose, the rim of each mount is provided with a bracket fitting the side of the nose. The effect of this is that the nose supports the bridge at three points, so that the frame is not fixed in position until all three points have found their approximate place. When in this position, the frame cannot slip sideways or up or down, nor can it tilt. The presence of the three rests has the advantage of distributing the weight of the spectacles over three fairly large surfaces, and thereby obviates all undue pressure and consequent irritation. The central bridge is adjustable within small limits, while the side rests are so arranged as to enable the optician to adapt the frame to any shape nose. The play of the side rests, the dis-

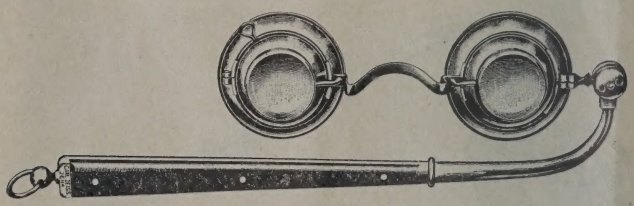

Fig. 16.—Binocular telescopic lorgnette, folded.

tance between them, and their lengths are readily adjustable. They are lined with celluloid or horn.

Besides being made up in the form of spectacles for constant wear, they are made up in lorgnettes for single or binocular vision, as shown in Figures 15 and 16. These are especially adaptable for women who believe the appearance too distressing.

TELESCOPIC MAGNIFIERS

When the fully corrected vision is below 20/200 (1/10) and in some cases below 20/100 (0.2), telescopic spectacles will be of little value, especially for near work. When the vision falls below 0.2, we must in some cases make use of the telescopic magnifier, and with vision below 10/200, it is the only method we have of improving visual acuity. Telescopic magnifiers are available with magnifying powers of 3 ×, 6 × and 8 × for distance use, and up as high as 32 × for near use.

The principle of the telescopic magnifier is that of a prismatic telescope, with the magnification mentioned aobve. The object is viewed after its enlargement by means of a pair of mirrored prisms. In its earliest

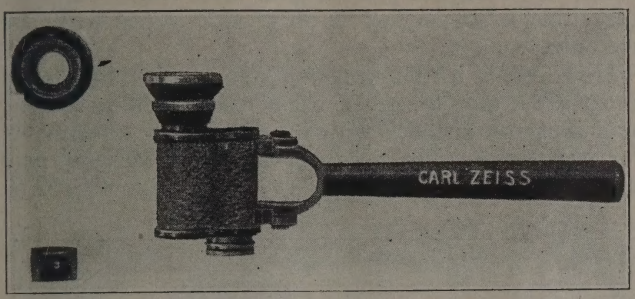

Fig. 17.—Telescopic magnifier with an additional lens for the objective of + 3 diopters and one for the eyepiece of — 15 diopters.

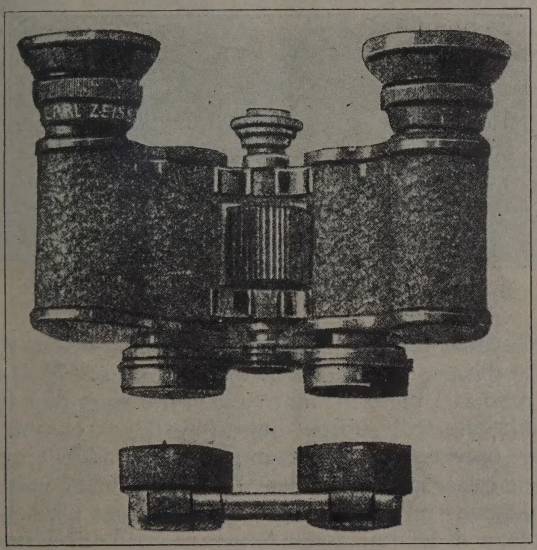

Fig. 18.—Binocular telescopic magnifier consisting of a binocular telescope of short interobjective distance and additional lenses.

form, it was first proposed by Ignazio Porro in 1850, and was made into a practical instrument by Ernst Abbe in 1893.

Telescopic magnifiers are available either for use with one eye, monocular, or for use with both eyes, binocular. The binocular telescopic magnifiers have the material advantage that they enable objects to be seen in solid relief. Solid objects present a far more realistic appearance than when viewed through a magnifier with one eye only.

However, as a rule, in poor vision or when one eye is much worse than the other, use is made of the monocular magnifier for distance with the front lens attachments for near work. For distance, ametropic patients may wear their own correcting glasses in conjunction with

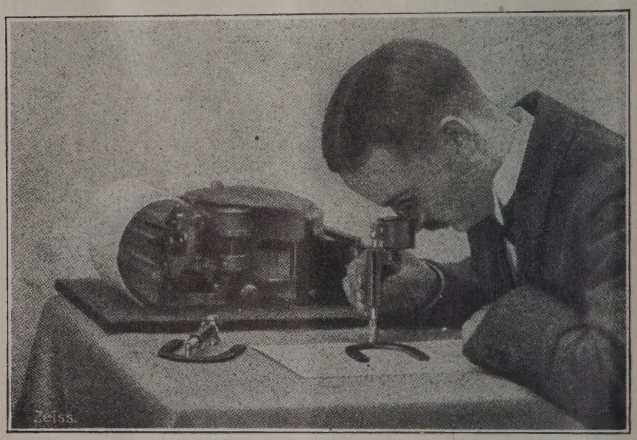

Fig. 19.—Monocular telescopic magnifier on a U-foot.

the telescopic magnifier, or a correcting glass may be fitted in the eye side of the instrument (Fig. 17).

To read at 1 meter or more away, the magnifier without additions will suffice; but to read nearer and for writing, object-side attachments must be added just as with the telescopic spectacles. The amount of enlargement depends on the object-side attachment used. For example, a + 16 object-side lens is as 16/4 (or 4 times), and this in conjunction with a magnifier of 6 × gives a total enlargement of 24 times (6 × 4). A patient having a vision of 1/60 will with this telescopic magnifier have a vision of 1/10 for distance, and with the object-side attachment 2/5 which practically suffices for reading. Naturally, with the enlarging there is a relative

decrease in the field of view, and the greater the magnification the smaller the field.

Table 2 shows the magnifications by use of the various telescopic magnifiers for distance with the magnification object-side attachments added for near, as well as the free viewing distance and the field of vision obtained.

For example: A telescopic magnifier of 6 × with an objective front lens attachment + 8 gives a magnification of 12 times. The free viewing distance is 12 cm. and the field of view is 16 mm. in diameter (line 8 in Table 2).

TABLE 2.—*Magnifications*

Objective Front Lens Attachment			Telescope 3× Light-Transmitting Capacity : 20.25		Telescope 6× Light-Transmitting Capacity : 6.25		Telescope 8× Light-Transmitting Capacity : 3.5	
Dp.	Magnification	Object Distance, Cm. About	Magnification	Field of View, Diam., Mm. About	Magnification	Field of View, Diam., Mm. About	Magnification	Field of View, Diam., Mm. About
+ 1	0.25	100	0.75	220	1.50	110	2.00	84
+ 2	0.50	50	1.50	120	3.00	62	—	—
+ 3	0.75	33	2.25	85	4.50	45	6.00	30
+ 4	1.00	25	3.00	60	6.00	32	—	—
+ 5	1.25	20	3.75	47	7.50	23	10.00	16
+ 6	1.50	18	4.50	38	9.00	20		
+ 7	1.75	14	5.25	34	10.50	18		
+ 8	2.00	12	6.00	30	12.00	16		
+ 9	2.25	11	6.75	27	13.50	14		
+10	2.50	10	7.50	24	15.00	13		
+12	3.00	8	9.00	20	18.00	11		
+14	3.50	7	10.50	17	21.00	9		
+16	4.00	6	12.00	14	24.00	8		
+19	4.75	5	14.25	12	28.50	7		

The telescopic magnifiers are supplied with various attachments, each of which has its advantages according to its use.

Reading by the Aid of the U Foot.—The U foot suggested by Dr. Erggelet provides a very handy and ever ready device for use. It can be carried about, and has the distinct advantage that, instead of the attention being every now and then diverted on the restoration of a sharp focus, it retains the printed matter in focus without effort, thereby enabling a person to devote his undivided attention to the work in hand. When used in study or business, it may be suspended by a leather strap or cord from the neck. This will enable the user to work and move freely about the room without having to relin-

quish the apparatus. The U foot may be folded up and therefore easily carried about in the pocket (Fig. 19).

Reading by the Aid of the Head Band or Head Clip.—In cases in which the use of both hands is necessary, one may use the telescopic magnifier attached to a head band or head clip (Fig. 20).

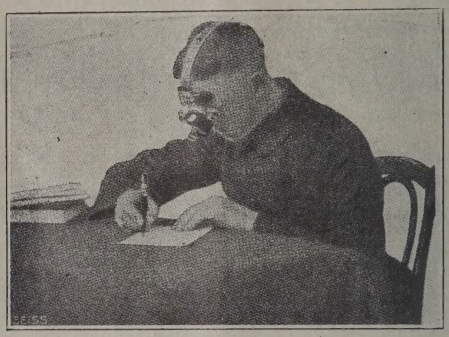

Fig. 20.—Monocular telescopic magnifier attached to a head clip.

Fig. 21.—Binocular telescopic magnifier with illuminating attachment and head band.

One may then write, or do the work that requires the use of both hands. The band and head clips are very tiring, but in a short time one accustoms oneself to them. When necessary, an illuminating attachment may be added (Fig. 21).

Reading with a Lens Stand.—This method is very similar to the Erggelet [1] horseshoe stand, in which the magnifier may be focussed on the object by means of a fine adjustment on the lens stand.

Reading with the Magnifier Held in the Hand.—To hold the magnifier in the hand and adjust for distance as well as near work is the most difficult of all methods in use (Fig. 23). Besides viewing the object, one must hold the magnifier close to the eye and adjust it without losing the field of view. In reading, it is necessary to

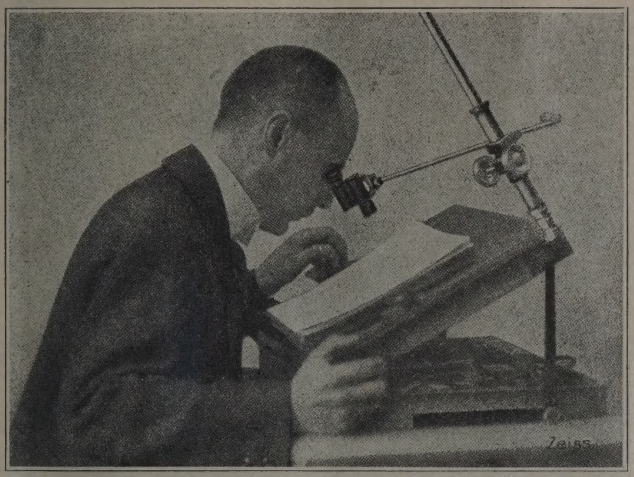

Fig. 22.—Reading with a special reading desk.

move the magnifier along the reading matter very carefully, for, owing to the great magnification, the place is easily lost.

A Special Reading Desk.—There is available also a special desk in which the reading matter attached is slowly moved along, being kept in the same focus at all times (Fig. 22).

The Use of Binocular Telescopic Magnifier.—The use of this instrument is much restricted, as it is unusual to have a patient deficient in vision equally in the two eyes to such an extent that this instrument is necessary. The adjustment is extremely difficult, and practical

1. Erggelet, H.: Ein neuer Fernrohrlupenfusz, Ztschr. f. ophth. Optik **4**, 1916.

experience has shown that it is not very useful for the weak-sighted.

By appending lenses over the object-side (Fig. 18), the binocular telescopic magnifier may also be used for viewing close objects. A cross section of the instrument is shown in Figure 24, with the appended lenses *L* focusing on the object *O* in the plane *F F*.

The axes of the telescopic elements remain parallel; the object by means of object lens attachments is projected as an image in the distance, and then clearly observed through the oculars of the telescopic magnifier

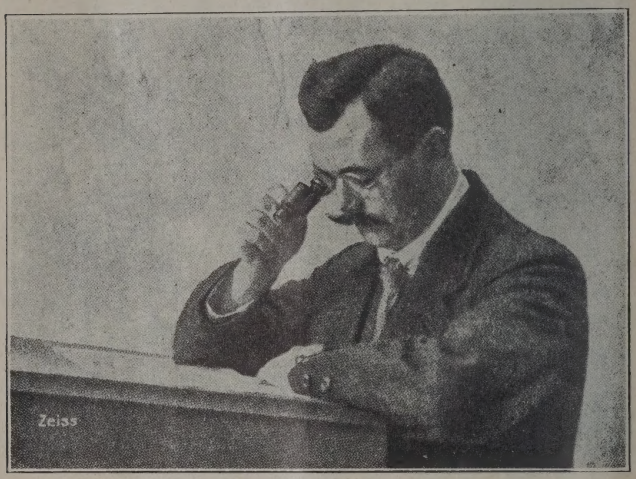

Fig. 23.—Reading with the magnifier held in the hand.

binocularly. Consequently, a complete binocular image is seen by use of these front lens attachments, viewed at short range. The front lens attachments are supplied for the binocular instruments in strengths up to 10 diopters.

Figure 25 is a graph that may be conveniently used to determine what combination of telescopic spectacles with object-side lens attachments, or telescopic magnifiers with object-side lens attachments, should be used to improve the fully corrected vision sufficiently to read. That amount, as previously discussed, must be 0.5.

Along the lower horizontal line of the graph, one finds the fully corrected vision of the patient. The

figures placed perpendicular to the right of the graph indicate the various system combinations used to improve vision. The figures placed perpendicular to the left of the graph indicate the magnifications obtained by use of the various combinations noted on the same line to the right of the graph.

The abscissas designate from the lower end of the graph the fully corrected vision, and wherever a particular abscissa crosses a perpendicular line, the combination noted to the right on the horizontal line where this crossing occurs will give the vision noted directly below where the crossing occurs, for example:

A patient with a fully corrected vision of 0.18 will, with the use of telescopic spectacles of 1.8 × magnification, and object-side attachment + 4, have a vision of

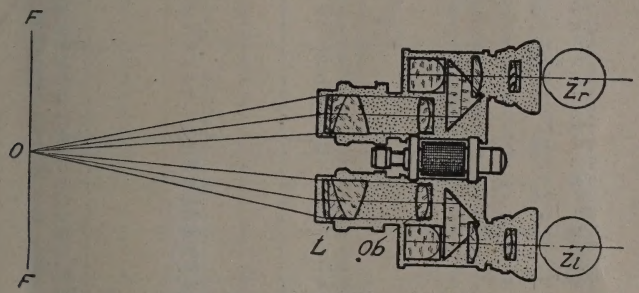

Fig. 24.—Cross-section of binocular telescopic magnifier.

less than 0.4; while, with an object-side lens of + 5, he will have a vision of almost 0.5. The same vision will be obtained with a 3 × telescopic magnifier and a + 3 object-side lens. A vision of 0.5 or half normal suffices for reading. In other words, wherever the abscissas cross the midline of the graph (0.5), that combination noted at the right is sufficient and the proper combination to prescribe for near work, or reading.

As noted by the graph, we can obtain the same enlargements by combinations either of the telescopic spectacles or of the telescopic magnifiers. A + 10 with a 1.8 system telescopic spectacle gives us the same enlargement as a + 6 with a 3 × telescopic magnifier or a + 3 with a 6 × magnifier; but the working distance with the spectacles is 10 cm., while with the 3 × magnifier it is 15 cm., and with the 6 × magnifier, 32 cm. It is also very important to note that there is a

much larger field of vision with similar enlargements of the telescopic magnifiers. Needless to say, the telescopic spectacles are more practical for use on account of the lesser weight and greater adaptability.

Table 3 gives the comparisons of the working distances as well as the differences in the fields of vision obtained with similar enlargements of the telescopic spectacles and telescopic magnifiers.

In explanation of this table let us take the example 1.8 × telescopic spectacles with a + 10 object-side lens.

TABLE 3.—*Working Distances and Differences in Fields of Vision*

System*	Magnification	Field of Vision, Mm.	Focal Distance, Cm.
TS 1.8 × + 2	0.9	135	50
TS 1.8 × + 3	1.35	90	33
TM 3 × + 2	1.5	116	50
TS 1.8 × + 4	1.8	67	25
TS 1.8 × + 5	2.25	54	20
TM 3 × + 3	2.25	76	32
TS 1.8 × + 6	2.70	45	17
TM 3 × + 4	3.00	57	24
TM 6 × + 2	3.00	62	50
TS 1.8 × + 7	3.15	39	14
TS 1.8 × + 8	3.6	34	12.5
TM 3 × + 5	3.75	46	19
TS 1.8 × + 9	4.05	30	11
TS 1.8 × +10	4.5	27	10
TM 3 × + 6	4.5	38	15
TM 6 × + 3	4.5	40	32
TM 3 × + 7	5.25	33	13.5
TM 3 × + 8	6.00	29	12
TM 6 × + 4	6.00	30	24
TM 3 × + 9	6.75	25	11
TM 3 × +10	7.50	23	10
TM 6 × + 5	7.50	24	29
TM 6 × + 6	9.00	20	15
TM 6 × + 7	10.5	17	13.5
TM 6 × + 8	12.0	15	12
TM 6 × + 9	13.5	13	11
TM 6 × +10	15.0	12	10

* TM, telescopic magnifiers; TS, telescopic spectacles.

This has a field of vision 27 mm. in diameter. Using the telescopic magnifier with the same enlargement (4.5 ×) there is a larger field of vision of 38 mm. in size with a 3 × magnifier and a + 6 object-side lens; and a 40 mm. diameter for a 6 × magnifier with a + 3 object-side lens. The focal distance with the spectacles is 10 cm., in contrast with 15 and 32 cm. for the telescopic magnifiers, respectively. It will be readily seen that in some cases the use of telescopic magnifiers will give better results than the telescopic spectacles, in spite of their increased size and more difficult usage.

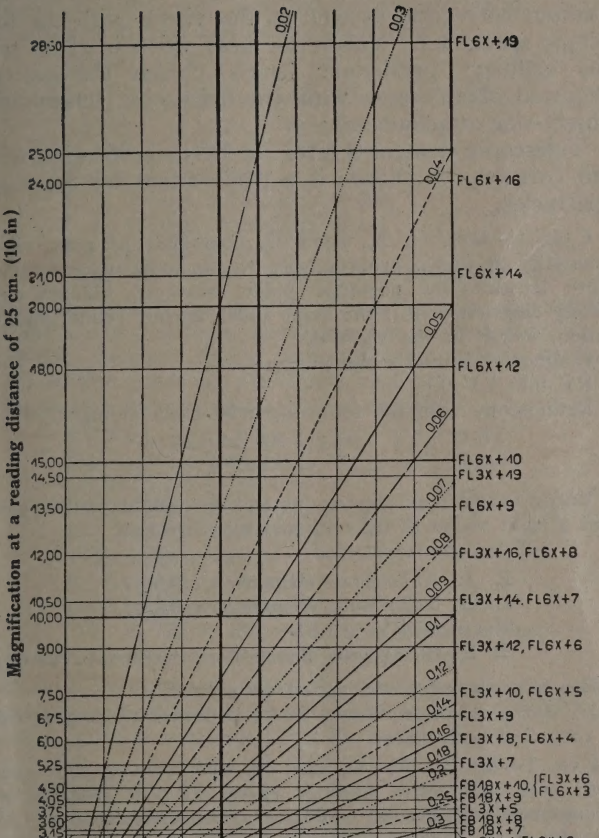

Fig. 25.—Graphic chart for determining a magnifying system affording an adequate improvement of vision in cases of amblyopia of a known degree. *FB*, telescopic spectacles; *FL*, telescopic magnifier.

REPORT OF CASES

We give briefly the histories of sixteen cases in which distals were fitted, the patients being taken from our private practice. The ordinary vision is given with and without correction as well as the vision with the telescopic spectacles. Vision for near work is given with the ordinary presbyopic lenses (when the patients required them) and with the telescopic lenses with object-side attachments.

Telescopic element 0 refers to 1.8 magnification without correction. Distals is a trade name for telescopic spectacles.

CASE 1.—Mrs. O. A., aged 47, complains of poor vision, especially at night, progressively worse. Objective findings: Both lenses show posterior polar cataracts. Media clear. Waxy degeneration of the disks and branched retinal pigmentation, worse in the right eye.

Diagnosis: Retinitis pigmentosa.

RV 0.1; LV 0.1.

Retinoscopy with the following trial case findings:

$+0.37 \frown + 1.00$ cyl $100 = 0.2+ 1$
$-0.50 \frown + 1.25$ cyl $90 = 0.1?$

Vision varied from day to day and on some days the patient had a right vision of 0.2 without any correction.

Telescopic spectacles:

R. E. Telescopic element $0 = 0.6—2$
L. E. Telescopic element $0 = 0.2+1$
For near RV $+ 1.50 = J\ 5$
R. E. Distal with object-side attachment $+ 4 = J\ 1$

Reads newspapers and fiction satisfactorily.

LV for near unsatisfactory and not needed as long as right is corrected with distals.

CASE 2.—Mr. L. W. W., aged 65, complains of poor vision both eyes. Objective findings reveal in both maculae and circummacular areas old extensive inflammatory changes with atrophy of the choroid and retina, and extensive pigmentation.

Diagnosis: Bilateral chorioretinitis centralis.

RV $0.1+ 1$; LV > 0.1

Retinoscopy revealed an emmetropic right eye; +3.00 in L. E.

Telescopic spectacles:

R. E. Telescopic element $0 = 0.3$
For near RV $+7.00 = J\ 5$
Distal with object-side attachment $+ 8 = J\ 2$

Reads newspapers, typewritten letters and fiction satisfactorily. The left eye was too poor to attempt the use of

distals. Telescopic magnifier 6 × with object-side +6 R. E. gave J 1.

Case 3.—Mrs. S. S., aged 43. Poor vision. Patient is a high myope showing a marked peripapillary atrophy of the choroid and retina with extensive myopic choroiditis.

Diagnosis: Myopia and myopic choroiditis.

RV > 0.1; LV > 0.1

Retinoscopy with the following trial case findings:

—23.50 ⌒ —1.75 cyl 40 = 0.3
—23.50 ⌒ —1.50 cyl 130 = 0.4
Telescopic spectacles:
R. E. (above correction) = 0.8
L. E. (above correction) = 1.0
For near B. E. J 2
Above Distals with object side attachments + 4 = J1

Case 4.—Mrs. J. A., aged 69, always has been near-sighted, but the vision has been decreasing for the last four years. Objective findings: central and peripheric opacity of both lenses so that fundi are not clearly visible.

Diagnosis: Bilateral cataract and myopia.

RV > 0.1; LV > 0.1
Manifest correction:
—9.50 ⌒ —1.50 cyl 0 = 0.1
—7.75 ⌒ —1.00 cyl 0 = > 0.1
For near RV +4.00 = J 6
Telescopic spectacles:
R. E. (above correction) = 0.2
L. E. (above correction) = > 0.1
R. E. Distal with + 8 object-side attachment = J 3

Reads newspapers and fiction satisfactorily.

Case 5.—Mr. M. M., aged 16, complains of poor vision associated with diabetes for which he is being treated with insulin. Objective findings: Pale disks and retinae.

Diagnosis: Bilateral optic atrophy.
RV > 0.1; LV > 0.1
Retinoscopy with the following trial case findings:
—5.50 ⌒ —1.50 cyl 0 = 0.1
—5.00 ⌒ —2.00 cyl 0 = 0.2
Telescopic spectacles:
R. E. (above correction) = 0.4 + 1
L. E. (above correction) = 0.6 — 3
For near R V J 3. Distal with object-side + 6 = J 1
L V J 3. Distal with object-side + 6 = J 1

Case 6.—Mr. I. J., aged 55. Injured in a dynamite explosion in March, 1923, both corneas being peppered with sand and dynamite particles. The right eye was apparently perforated by some of these fine particles. Objective findings: numerous small opacities of both corneas. R. E. traumatic cataract.

Diagnosis: Corneal maculae and traumatic cataract.
RV Light perception and projection; LV 0.2
Telescopic spectacles:
R. E. no improvement
L. E. telescopic element 0 = 0.5
For near L. E. + 3.00 J 4. Distal object-side + 5 = J 1

Case 7.—Mr. P. K., aged 77. Progressive decrease of vision for the last two years. Objective findings: nuclear and perinuclear opacities of both lenses. R. E. area of absorbed hemorrhage between macula and disk. L. E. around macula are remains of old absorbed hemorrhages.

Diagnosis: Cataracts and bilateral albuminuric retinitis.
Manifest correction:
R. + 1.50 ⊃ + 1.50 cyl 0 = > 0.1
L. +1.50 = 0.3 + 1
Telescopic spectacles:
R. E. (above correction) = 0.1 + 1
L. E. (above correction) = 0.6 + 2
For near L. E. + 3.00 = J 3. Distal with object-side + 6 = J 1. Reads newspapers, small print and fiction with ease. Prescribed L. E. only.

Case 8.—Mr. A. J. T., aged 32. Poor vision and difficulty in reading. Parents are consanguineous. Objective findings: Disks are atrophic with waxy degeneration. Retinas show typical branched pigmentation.

Diagnosis: Retinitis pigmentosa.
Retinoscopy with the following trial case findings:
—6.50 ⊃ —2.00 cyl 170 = 0.1
—5.00 ⊃ —2.50 cyl 170 = 0.1
Telescopic spectacles:
R. E. (above correction) = 0.2
L. E. (above correction) = 0.1 + 1
For near R V J 6. Distal with object-side + 8 = J 1
For near L V J 9. Distal with object-side + 10 = J 2
Near glasses prescribed for R. E. only.

Case 9.—Mr. B. P., aged 29, complains of poor vision, progressively decreasing. Injured in the left eye in 1919 by a hammer blow. Treated and operated on several times. R. E. became inflamed two years later and the vision became worse. L. E. enucleated. R. E. operated on. Objective findings: Prothesis in left orbit. R. E. Descemitiitis. Operative coloboma of iris. Atrophy of the iris with scattered pigmentary adhesions to lens. Lens and vitreous hazy.

Diagnosis: Sympathetic ophthalmia, apparently result of operative intervention.
RV 0.2

Telescopic element: $0 = 0.3$
For near, J 5. Distal with object-side attachment $+6 = J\ 2$. Reads newspapers and small print satisfactorily.

Case 10.—Miss R. S., aged 17. Decreasing vision for the last three years. Objective findings: Around each macula, symmetrically arranged in a circle, are eight to ten punctate, yellowish areas surrounded by a slightly hyperemic base. Etiology undetermined. Absorptive and tuberculin therapy used.

Diagnosis: Central chorioretinitis.
RV 0.1; LV 0.1
Retinoscopy and trial case essential emmetropia.
Telescopic spectacles:
R. E. telescopic element $0 = 0.4$
L. E. telescopic element $0 = 0.4 - 1$
For near, J 3 with difficulty either eye.
Distals with object-side attachment $+ 6 = J\ 1$ either eye.
For music, Distals with object-side attachments $+ 3$ prescribed.
Telescopic magnifier $6 \times$ gave a visual acuity in each eye of 1.5.

Case 11.—Dr. S., aged 42, complains of poor vision and difficulty in reading. Objective findings: Fine lateral nystagmus, incipient opacities both lenses. Some atrophy of the retinas but no definite lesions.

Diagnosis: Myopia and cataracts.
RV > 0.1; LV > 0.1
Retinoscopy with the following trial case findings:
R $-6.50 \frown -2.00$ cyl $25 = 0.2 + 1$
L $-5.50 \frown -1.00$ cyl $45 = 0.4 - 1$
Telescopic spectacles:
R. E. (above correction) $= 0.8 - 2$
L. E. (above correction) $= 0.6 - 1$
For near RV $+ 1.00 = J\ 3$
For near LV $+ 1.00 = J\ 3$
Distals with object-side attachment $+ 4 = J\ 1$ each eye.

Case 12.—Miss R. G., aged 55. Decreasing vision complained of for the last twelve years. Objective findings: Both lenses show an opaque hard yellowish nucleus with cortex fairly clear. Fundi cannot be seen.

Diagnosis: Bilateral cataract; myopic choroiditis.
R. E. operated and cataract removed. (Extensive myopic changes.)
RV L. P. & P. before operation; > 0.1 after operation uncorrected; LV > 0.1
Manifest correction.

R + 4.00 ⌒ + 3.00 cyl 20 = 0.3 — 1
L —18.00 = >0.1
Telescopic spectacles:
R. E. (above correction) = 0.4
For near with + 4.00 = J 6 (ordinary correction)
R. E. Distal with object-side attachment + 6 = J 2

Reads newspapers and fiction satisfactorily.

Case 13.—Mrs. P. L., aged 64, complains of decreasing vision for the last four years. Objective findings: Lenticular opacities chiefly subcapsular and perinuclear. Around the macula of the right eye is a broad halo of exudate with a fresh process below.

Diagnosis: Bilateral cataract; retinochoroiditis.
RV 0.2 — 1; LV 0.2
Retinoscopy with trial case findings:
R + 0.50 = 0.3
L + 0.50 = 0.3 + 1
Telescopic spectacles:
R. E. (above correction) = 0.5 — 1
L. E. above correction) = 0.8 — 2
For near R + 3.50 = J 5
For near L + 3.50 = J 2
Distals with object-side attachment R + 6 = J 1
L + 4 = J 1

Prescribed to use eyes singly for reading.

Case 14.—Mrs. N., aged 66. Gradual decrease in vision for the last twelve years. Objective findings: Both lenses show diffuse nuclear opacity without peripheric striae.

Diagnosis: Bilateral cataract.
R V 0.1; L V 0.1
Retinoscopy with trial case findings:
R + 0.50 = 0.2 + 1
L + 1.50 = 0.2 + 1
Telescopic spectacles:
R. E. (above correction) = 0.6 — 3
L. E. (above correction) = 0.4
For near + 4 = J 3 both eyes. Distals with object-side attachments + 6 E. E. = J 1

Case 15.—Miss C. H., aged 9, has always been near sighted, progressively worse each year. Objective findings show little distortion of the fundi except for myopic conus.

Diagnosis: Progressive myopia.
RV >0.1; LV >0.1
Retinoscopy with the following trial case findings:
— 13.00 ⌒ —3.00 cyl 0 = 0.2
—15.00 ⌒ —2.00 cyl 0 = 0.3 — 1
Telescopic spectacles:
R. E. (above correction) = 0.5 — 2

L. E. (above correction) $= 0.8 - 1$
For near B. E. J 3
Distals with + 4 E. E. = J 1

CASE 16.—Miss M. S. (seen through courtesy of Dr. W. Moncrieff), aged 18. Poor vision since 5 years. Accidental primary lesion at age of 6, followed by secondaries in a few weeks. At the age of 13 a sudden attack of crossed paralysis (right leg, left arm) with total blindness, deafness and temporary coma occurred. These symptoms followed complaints of headaches and vomiting, which lasted several weeks. Complete examination at the time found the blood and spinal fluid Wassermann positive and the diagnosis of cerebrospinal syphilis and gumma was made. Under intensive antisyphilitic treatment resolution of all changes except ocular occurred. Objective and subjective ocular findings: R. E. Form field limited to a 10 by 30° island in the lower temporal quadrant. L. E. Form field narrowed only 10 to 20° in the upper and nasal half. Both disks are pale white, the right more so than the left. There are no vascular or retinal changes outside the disk.

Diagnosis: Bilateral optic atrophy.
RV Light perception; LV 4/200
Atropin refraction shows both eyes emmetropic.
Telescopic magnifier:
L. E. Telescopic magnifier $6\times = 0.3 + 1$
For near L. E. + 4.50 (ordinary correction) = J 10
L. E. Telescopic magnifier $6\times$ with object-side lens $+ 6 = J\,3$; with object-side lens $+ 10 = J\,1$

Patient was supplied with an Erggelet U stand, and a special reading desk.

COMMENT

On account of the desire for patients to see with both eyes for distance as well as near work, many difficulties have been encountered. As previously discussed, for distance use parallel axes of the telescopic elements are necessary, and for near converging axes, as shown in Figure 7. Even with separate spectacles for near work, patients have had great difficulty in adjusting them properly to see binocularly at the reading distance.

Zeiss provides adjustable spectacle magnifiers, as shown in Figure 26, which permit changes in the interpupillary distance from 56 to 75 mm., also regulating the height, but do not have any adjustments regulating the convergence or divergence of the two telescopic elements. We make this suggestion knowing (through the experience we have had with some of our cases) that, if the interpupillary distance and also the angle of con-

vergence of these telescopic elements could be changed by the physician, optician or even the patient, the patient would quickly become accustomed to their use for near and far work binocularly. With the present frames, it has been extremely difficult to maintain the proper angle of convergence; consequently, the patient at times complaints of diplopia, headaches and unsatisfactory results. When viewing an object through the two combinations, he is unable to fuse the two component images into a single stereoscopic impression.

A complaint by the patient of color fringes and an indistinct image furnishes in all cases an immediate indication that the distance between the telescopic elements does not conform to the position of the visual

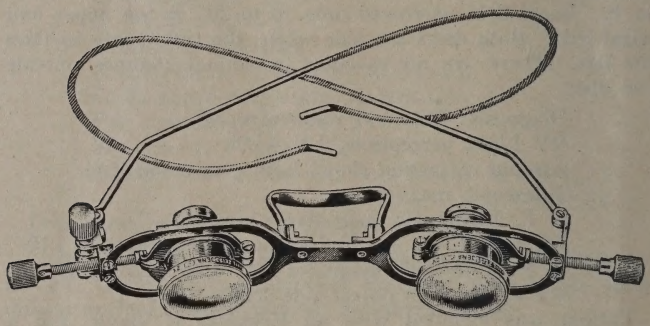

Fig. 26.—Adjustable spectacle magnifiers.

axes, or that the respective axes of the magnifiers and the eyes are not directed in like manner. If the two elements are not at the same level in front of the eyes, it will be impossible (or possible only with a great effort) to fuse the two component images into one. With many persons, small deviations from the proper elevation may suffice to vitiate binocular vision.

The results of our studies and experiments with our cases have satisfied us that telescopic spectacles and magnifiers may be successfully used in many cases of poor vision in which, with the best ordinary correction, we are unable to secure satisfactory vision. Most of our patients were unable to read the newspaper until they secured the telescopic spectacles. Our work with the telescopic magnifiers has been practically nil, but we plan to make an extensive study in some of our institutions for the blind with the view of making some of the

patients economically useful at certain types of work. There must be thousands of persons in this country whose vision could be materially improved by the use of these lenses, and made economically useful and much happier.

It has been found that a patient with a vision of 1/20 (0.05) and even less can orientate himself, get around the streets, but is unable to read, write, or make out things at close range. The same patient, equipped with a telescopic magnifier, will be able to read signs on the street and get about without inquiry and at the same time, properly fitted with object-side lens attachments, can read and write satisfactorily.

We have stated that it is imperative to give the full correction worn by the patient, otherwise the opposite effect is produced by the telescopic combinations. Examination of our records will show that in a few cases we did not adhere strictly to this rule. Repeated examinations with these few patients revealed the fact they could see better with the corrections prescribed. Furthermore, it has been our desire, wherever possible, to order spherical corrections only, these being procurable in this country; cylindric corrections, for the time being, must be secured from abroad.

There is one point we cannot impress too much. Time and patience by the physician, optician and patient are very necessary. It has not been unusual for us to spend an entire morning fitting a pair of these spectacles. Adjustments time and time again are necessary. The patient will try them on and find he is unable to read or see well, owing to the change in the apparent distances of objects as well as the enlarging effect produced by their use. He must try and try for hours and even a few weeks, and after a while he will become accustomed to the changes produced and will see much better than at first trial examination. Every patient we have fitted came back after a few days unable to see well with their telescopic spectacles. Unfortunately, they expect better results than the marvelous result obtained, a peculiar trait of human nature always wishing for improvement. Again let us emphasize the necessity for perseverance on the part of the patient for weeks, as well as the necessity for the physician and optician to aid in such changes and adjustments as are necessary from time to time.

In a few cases we have been able to make use of the binocular "theatroskop" made by several German concerns, such as the Busch. It is built on the principle of the Dutch telescope, and has an enlargement of 3 ×. It is made in the form of spectacles. The object-side lens is adjustable so that the individual elements may be focused for far or near. It is arranged for changes in the interpupillary distance, but has no adjustment to allow convergence of the single elements, and therefore cannot be used binocularly for near use.

We apologized for the use of the ordinary test charts in recording the visual acuity of a patient, calling attention to the use of the amblyopic charts suggested by Professor Henker.[2] However, careful examination of our records will reveal that in certain cases a visual acuity of almost three times was obtained by the use of the 1.8 times telescopic spectacles. We also found some cases in which the telescopic spectacles made little improvement in visual acuity. We are led to believe by these findings that in some cases the retinal enlargement produced by the telescopic system brings the image on certain retinal perceptive elements which have not been involved in a disease process. In Patient 10 of our series, the normal vision was 0.1, with the telescopic spectacles 0.4, and with the 6+ magnifier, 1.5. Objectively there is a disease process involving the macula alone. The telescopic systems enlarge the image which falls on normal fibers surrounding the macula, and therefore visual acuity is greatly increased out of proportion to the system magnification. A similar condition must exist in Patient 16, in whom the normal vision of 4/200 (improved only to 8/200 with telescopic spectacles 1.8 ×) was improved to 0.3 + 1 with a 6 × telescopic magnifier. (By knowing the size of the test letter that is seen by the uncorrected eye, we should be able to measure the size

2. Henker, O.: Ueber die richtige Wahl vergrößernder Korrektionsmittel bei verschiedenartiger Herabsetzung des Sehvermögens, Arch. f. Augenh., 1916, 81 Ergänzungsheft, S 67-81; Ueber den Gebrauch der Fernrohrlupen und Fernrohrbrillen durch Augeninvaliden, Ztschr. f. ophth. Optik **4**: 12-21, 1916; Vergrößernde Systeme für Augenbeschädigte, Ztschr. f. Kriegsbeschädigten Fürsorge in Ostpreuszen **2**: 54-56, 1917; Ein enfacher Fernrohrbrillen-Probierkasten, Ztschr. f. ophth. Optik **4**: 43-59, 1916. Henker and von Rohr: Ueber binokuläre Lupen schwacher und mittlerer Vergrößerung, Ztschr. f. Instrumentenkunde **29**: 280-286, 1909. Henker, O.: Ein Lesepult für Schwachsichtige, Deutsch. opt. Wchnschr. **1**: 511-512 (June 4) 1915-1916; Einführung in die Brillenlehre.

of the lesion in the fundus in those cases in which the telescopic system gives a visual acuity better than expected by the given magnification.)

Visual education in amblyopic children may be aided by the use of telescopic spectacles. In Patient 15, another case in which visual acuity is improved out of proportion to the system magnification used, the fully corrected vision is R 0.2; L 0.3—1; with Distals R 0.5—2; L 0.8—1. There is no question that the mental development of this child will be greatly facilitated by the improvement in vision resulting from the use of Distals during her school years.

Patients noticing gradual or sudden decrease in vision and fearing blindness are given great mental encouragement by being shown that visual acuity can be restored by the use of telescopic spectacles and magnifiers.

Between 1914 and 1918 in Jena, 148 patients (seventy war injuries) were fitted with telescopic spectacles and magnifiers. Careful records were made by Raefler,[3] and in a questionnaire sent out a few years lat[redacted]ésumé gave the following conclusions: Seventy per cent. needed these instruments to do their work; 50 per cent. were able to take up their previous occupation which they could not do otherwise, and 90 per cent. were able to read and write satisfactorily with their new glasses.

We are greatly indebted for the assistance given us by Mr. P. Leonhardt of the local Zeiss Company, and to Mr. Weinstein of Almer Coe & Company for his tedious, untiring efforts in repeatedly adjusting these spectacles.

Illustrations, charts and photographs have been taken from the various writings of Henker, Stock[4] and von Rohr.[5]

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